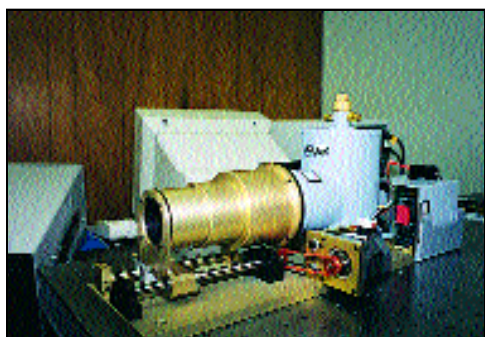


## ADVANCED IMAGING SPECTROMETER



● The IMSS imaging device can help detect bioluminescence in dangerous bacteria.

### BMDO HISTORY

Pacific Advanced Technology, Inc. (PAT; Solvang, CA), has developed an imaging spectroradiometer that can be used to detect and identify chemicals and biological matter for military, environmental, law enforcement, and medical applications. Called the image multispectral sensor (IMSS), this technology is based on advances in diffractive optics and image and signal

processing. It images a scene in three dimensions, two spatial and one spectral, to build a multispectral spatial imaging cube of data.

**Bioluminescence, a trait**

**found in the familiar firefly,**

**is a natural phenomenon**

**that has enabled biologists**

**to develop clever ways to**

**track gene expression in**

**animals. For instance, a**

**glowing protein found in**

**jellyfish has been success-**

**fully incorporated as a**

**reporter gene in transgenic**

**laboratory mice.**

BMDO funded PAT's multispectral sensing technology in 1995 through the SBIR program in a joint project with Amber, a Raytheon company (Goleta, CA). Amber and BMDO provided \$150,000 each for the project. With IMSS technology, BMDO could detect theater missiles in clutter, identify friend or foe, and detect and identify chemical agents. PAT previously obtained a BMDO SBIR Phase I contract outside this teaming arrangement.

### HOW IT WORKS

While other spectral imaging devices have very complex optics and require exact alignment, PAT's instrument uses a simple optical design that allows for relaxed tolerances on optical alignment. Rugged and portable, it can operate in harsh environments such as airborne and space-based platforms.

PAT has commercialized this instrument with joint funding from the BMDO SBIR program and Amber. Amber sells the commercial IMSS as an attachment to its RADIANCE 1 and Galileo cameras to make a midwave infrared multispectral radiometric imager, useful for spectroscopy and radiometry. PAT supplies Amber with the multispectral lens system as well as the image- and signal-processing software called HYPAT. This system uses an  $f/2.5$  nominal 102-millimeter focal length lens and covers the full 3- to 5-micrometer spectral band with a spectral resolution of less than 0.01 micrometers. Using the Galileo camera in the highest data acquisition mode, spectral images over the 3- to 5-micrometer band with 400 spectral bins can be collected in less than 1 second.

#### MEDICAL SIGNIFICANCE

PAT's multispectral imaging device is an ideal instrument for collecting optical signatures from biological matter, whether the task is to identify bacteria or a cancerous lesion. Bioluminescence systems are already in use for rapidly detecting the presence of *E. coli*, for example, in foodstuffs. For identifying cancers without surgical sampling of the suspicious area, optical biopsy is very close to clinical adaptation in a number of institutions. The IMSS can also be used for reading the optical signatures of tumors and for localizing them in a 3-D image. The device has an adaptive spectral filter that can separate excitation light from emission light; this is critical for the fiber-optic system that both delivers and collects light in the optical biopsy system.

If the capability of the IMSS is extended to longer wavelengths, the technology can be used to detect and identify chemical agents, such as sarin and other nerve gases. Through an Air Force SBIR Phase II contract, PAT is designing a system that will detect signatures at longer wavelengths for chemical warfare applications.

#### VENTURES OR PRODUCT AVAILABILITY

PAT is a woman-owned small business focused on electro-optic research and development. The company has one patent on the IMSS technology. PAT supplies its lens product to Amber, which has sold two RADIANCE 1 systems with the lens for military use. Another order is pending. Systems including the Amber camera cost roughly \$70,000.

With the IMSS technology, Amber and PAT are focusing on applications to remotely monitor smokestack emissions and, in 1995, demonstrated promising results in the field. From 1 kilometer away, PAT's system detected carbon monoxide, carbon dioxide, and hydrocarbons from two smokestacks at an oil refinery. PAT is interested in demonstrating its technology to detect sulfur dioxide for environmental applications.

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